The 6th International Conference on Current and Future Trends of Information and Communication Technologies in Healthcare (ICTH 2016)

Strategic Value of Cloud Computing in Healthcare organisations using the Balanced Scorecard Approach: A case study from A Saudi Hospital

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Abstract

The evolution of Cloud Computing over the past few years has the potential to provide many benefits for healthcare organisations. However, healthcare organisations still need to discover the strategic values of adopting such a technology model. The paper discusses the strategic value of implementing Cloud Computing solutions in a Saudi hospital based on the Balanced Scorecard Approach. The paper also presents the strategy map and the KPIs that were used by the hospital. The results of this paper (KPIs, strategy map.) could act as guidelines for similar projects and similar organisations, while taking into consideration the uniqueness of each organisation.

Keywords: Cloud Computing; e-health; Balanced Scorecard; Saudi Arabia; Case Study.

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doi:10.1016/j.procs.2016.09.050

1. Introduction

Healthcare providers look to use Information Technology (IT) to gain the competitive advantage that IT usually provides. A Health Information System (HIS) is an integrated system that involves people, processes and technologies to support healthcare services [1] and includes financial, administrative and clinical aspects. The benefits of implementing IT solutions in healthcare organisations include enhancing medical practices, supporting decision-making processes and simplifying information sharing [2]. However, current e-health practices face many challenges which include technical difficulties such as complexity, compatibility and insufficient IT infrastructure and financial and organisational issues such as the higher cost of implementing HIT projects [3]. Studies also showed that there are doubts about the value of implementing HIT projects among health professionals and hospital administrators [2].

The Balanced Scorecard (BSC) is a managerial tool that defines the current and potential status of the organisation based on specific and targeted objectives and measurements. BSC goes beyond typical performance measurement to be a popular strategic management tool that has been used widely [4]. The strategy map which is a central component of BSC is found to be beneficial for organisations by allowing better strategy execution [5]. The strategy map also allows the visualisation of organisations' strategic goals which facilitates strategic discussions among the mangers and other groups [6]. The BSC was chosen for this study because of its popularity among Saudi organisations and the flexibility it provides when making modifications to the perspectives [7]. Cloud Computing is an emerging IT model and understanding the potential value of Cloud Computing is important and could encourage the organisations to adopt this model of computing [8].

The aim of this paper is to show the strategic value of adopting Cloud Computing to healthcare organisations based on the balanced scorecard approach. This paper is organised as follows. Section II presents the concept of Cloud Computing. Section III describes the balanced scorecard and its implementations in a Saudi hospital. Section IV presents the analysis and expected result of the Balanced Scorecard followed by discussion of the study. Section VI concludes the paper.

2. Cloud Computing

Cloud computing is an emerging paradigm for delivering IT services used in many industries and sectors [9]. Cloud Computing can be defined as "an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location. The resources required to provide the requisite quality-of-service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction" [10]. Based on the deployment model, Cloud Computing can be divided into four types [10]. A public Cloud is a publicly accessible Cloud environment owned by a third-party Cloud provider. A private Cloud is owned by a single organization. Private Clouds enable an organization to use Cloud computing technology as a means of centralizing access to IT resources by different parts, locations, or departments of the organization. A community Cloud is similar to a public Cloud except that its access is limited to a specific community of Cloud consumers. A hybrid Cloud is a combination of a public and private Cloud where core business processes are kept within the organisation and non-critical processes are outsourced to the public Cloud provider. Cloud services can be offered as Software as a Service (SaaS), Platform as a Service (PaaS) or Infrastructure as a Service (IaaS). For healthcare organisations, Cloud Computing could offer some opportunities such as: reducing the cost of IT services, providing better patient care, supporting research activities [3]. However, healthcare organisations still have some concerns about Cloud Computing services such as the risk of systems unavailability, data security and privacy issues [3]. Very little academic research has addressed the Cloud Computing phenomenon in Saudi Arabia [11] and, in particular, none within the Saudi healthcare context. In this paper, we will discuss the adoption of Cloud Computing at a Saudi hospital to understand the potential value of Cloud Computing based on Balance Score Card (BSC) methodology.

3. Case Study

3.1. Introduction to Electronic Health Department at KFSH

King Fahad Specialist Hospital (KFSH) in Buraidah is a governmental tertiary referral hospital in Saudi Arabia with a total of 500 beds. The main aim of the hospital is to provide the highest quality of patient care. KFSH aims also to be the regional training and educational centre for medical and paramedical staff and students. In addition to the hospital, KFSH also has five medical centres. The hospital is undertaking a critical infrastructure upgrade and established an Electronic Health Department (EHD) to be responsible for developing an efficient and reliable IT environment to support medical services. The hospital implemented a commercial Hospital Management Information System (HMIS) in 2013 to serve as the base of HIT infrastructure with which other hospital systems should be integrated. However, the hospital faced performance issues with the existing IT infrastructure in that some servers were outdated or were built on outdated architecture. Thus, KFSH included upgrading some IT infrastructure as a part of the hospital upgrade project. EHD experienced also some difficulties in managing IT resources. For example, most of IT staff at the hospital focus on maintenance or routine operations rather than developing new ideas or projects. EHD managers believe that IT system should have the highest uptime possible. However, the maintenance type at the department is currently reactive (i.e. fixing the problem after it has already happened). As a result, EHD managers decided to implement IT solutions to achieve the following strategic objectives:

- Increase IT staff productivities and creativities which will lead to improvement in IT services.
- Increase IT resources utilisation.
- Improve information sharing inside and outside the hospital.
- Enhance IT resources availability.
- Improve customers' satisfaction.
- Improve Cost structure.

3.2. Cloud Computing solution

The IT team at KFSH decided to adopt a private Cloud solution to achieve their IT strategic goals. The hospital already has an IT infrastructure and hardware which can be used in building a private Cloud Computing environment. Thus, adopting a private Cloud Computing solution will not require unnecessary infrastructure investment. Hospital management and other authorities still have some concerns about the security of a public Cloud and this was another reason for adopting a private cloud. Maintaining full control over the IT systems is another reason for choosing a private Cloud solution as this will support IT staff when managing IT services. A private Cloud will also allow for customisation of hardware, network and storage performance. The decision was taken to outsource the private Cloud operations to a third party organisation. This was because the hospital does not have enough qualified IT staff and also to gain access to the vendor's specialized technical skills. Deciding whether to adopt Cloud Computing is potentially a complex process and consequently there are many perspectives to be considered. Although the BSC will help the EHD department to determine the strategic value of adopting Cloud Computing, the department required a holistic framework that covers multi-perspectives at the hospital. Thus, the department implemented a Strategic Framework for Cloud Computing Decision-Making in Healthcare Sector to support the assessment process at the hospital, which has already been outlined in [12].

3.3. The Process of Building a Balanced Scorecard

EHD managers implemented the BSC to evaluate the strategic value of implementing Cloud Computing solutions at the hospital. BSC was chosen because this tool can be used as a performance measurement tool and/or a strategic management tool. BSC is also used to align EHD department with the hospital strategy. EHD managers hope that implementing the BSC could answer questions such as:

- Is the investment in Cloud Computing really worthwhile?
- Will Cloud Computing provide strategic value to the hospital?
- Will Cloud Computing provide operational benefits?

IT managers at the hospital followed a "Five-Stage" approach to build the Balanced Scorecard. The first stage was to map the EHD department vision and strategy and align this with the hospital vision and strategy. The second stage is to formulate the perspectives and the strategic objectives and decide on the weight of each perspective. Possible Key Performance Indicators (KPIs) were discussed at this stage. The third stage was to formulate the first drafts of BSC and the strategy map. The fourth stage was a revision process to obtain feedback from different stakeholders at the hospital. Then the final stage is to obtain final agreement among BSC and strategy map.

4. Strategic Value of Cloud Computing based on Balanced Scorecard

By using BSC, IT managers at KFSH tried to demonstrate the value that Cloud Computing can provide and also tried to highlight that Cloud Computing may lead to strategic continuous improvement rather than operational continuous improvement. Fig. 1-a and Fig. 1-b show the BSC approach and strategy map.
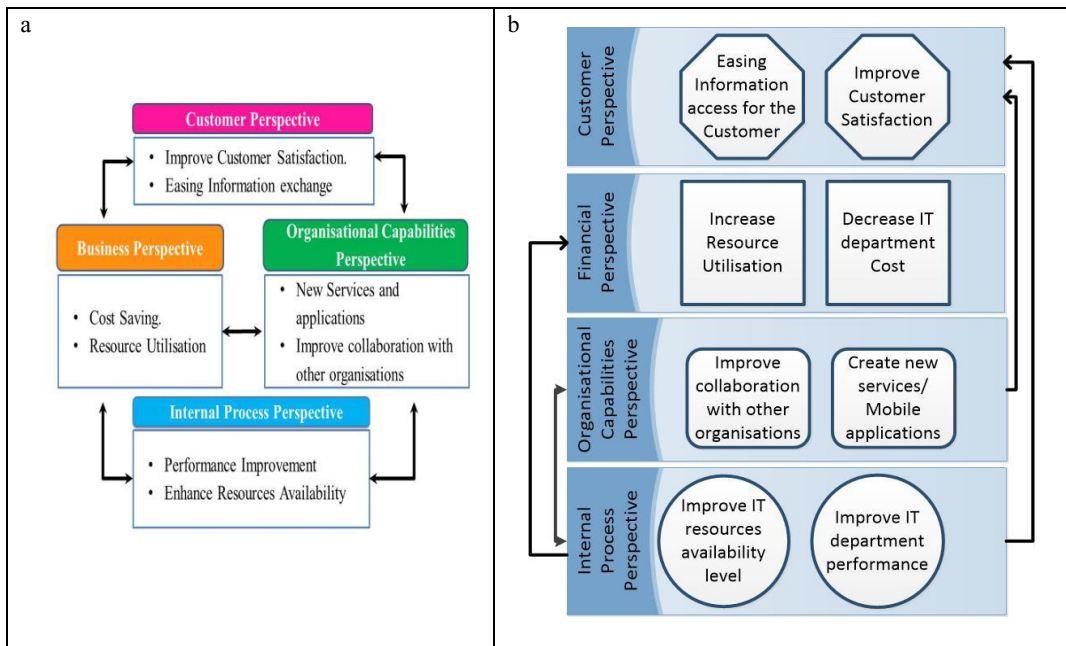

Fig. 1. (a) BSC of E-health department at King Fahad Specialist Hospital; (b) Cloud Computing Strategy Map: A Tool for Strategic Alignment at Saudi Hospital.

KFSH is a non-profit organisation which focuses more on operational excellence and no other strategies such as product leadership strategy or customer intimacy strategy were considered. IT managers adopted a mixed approach by combining operational excellence strategy with customer focus strategy. The BSC, shown in Fig. 1-a has been implemented by placing Customer perspective at the top to show the importance of this perspective. Process perspective has been placed at the bottom of BSC to show that this perspective is the basis of operational excellence strategy. The learning and growth perspective has been renamed Organisational Capabilities to reflect how the use of Cloud Computing will deliver new capabilities, skills and services for EHD customers. For financial objectives, IT managers estimated that Cloud Computing will lead to improvements in cost structure and asset utilisation. A strategy map was developed to show the high level objectives of BSC and also to indicate the causal relationship between these objectives (see Fig. 1-b). For each perspective, IT manager developed strategic objectives. Eight main objectives were chosen with 14 performance indicators as listed in Table 1.

Table 1 Measures selected for the Balanced Scorecard

	Strategic Objectives	Measurements	Current	Target	Initiatives
Customer	Improve Customer Satisfaction	Increase Customer Satisfaction	70%	90%	• Patient portal
	Easing Information access for the Customer	Increase number of visits to hospital websites	1000	5000	• Self-service stations
		Increase number of Self-service stations for Patients	0	10	• Staff portal
		Increase Number of number of hospital mobile application download	0	1000	• Mobile Application
Financial	Decrease IT cost	Decrease overall IT cost	30% of Hospital budget	15% of Hospital budget	• Total Cost of Ownership
	Increase Resource Utilisation	Increase Percentage of servers that are virtualized	20%	70%	
		Decrease number of staff allocated to servers maintenance	3	1	
Organisational Capabilities	Create new services	Increase number of mobile devices supported	0	100	• Mobile Application
		Increase number of hours spent on innovation/ projects	2	5	• Online Patient
	Improve collaboration with other organisations	Increase number of external interfaces with other organisations	2	20	• Transfer request
		Increase number of centres that support IT department	2	5	
Internal Processes	Improve IT department performance	Decrease maintenance time	18 days per month	12.6 days per month	• Proactive Care
		Decrease help desk response time	72 hours	24 hours	• Load Balancer system
	Improve IT resources availability level	Increase network uptime during business hours	98%	99.99%	• Virtualisation
		Increase application uptime during business hours	98%	99.99%	
		Decreased unplanned downtime	10 hours	1 hours	
		Decrease application downtime during the planned maintenance	80%	1%	

The EHD department implemented BSC as a strategic and measuring tool to identify the expected strategic value of implementing a Cloud Computing solution. Selecting key performance indicators with specific criteria was an important task. The mangers discussed the BSC and the proposed KPIs with key stakeholders. The chosen KPIs must (1) align with the hospital vision and strategy, (2) better represent the assigned strategic objective and (3) has a clear benchmark performance for future measurement and evaluation (see Table 1). Two benchmark approaches were followed which are benchmarking against similar industries and the use of opinions from internal experts.

4.1. Process Perspective:

As IT services are the core business of the department, the process perspective will be an important metric. Careful consideration was given to choosing appropriate objectives and performance measures that reflect critical internal processes. Strategic objectives relating to internal business process could be spilt into department performance and

IT resources availability. Performance measurements must show and assess how well the department supports the customers [13]. Cloud Computing technologies such as virtualisation eases maintenance efforts and relieves the burden of maintenance cost [10]. Thus, first objective is to improve the performance by reducing maintenance time and help desk response time. The second objective is to enhance the availability of IT resources. Cloud Computing was seen to deliver this strategic goal [14]. The resource pool characteristic of Cloud Computing allows applications and services that run in virtual machines to be moved between servers when physical server fail is detected. Such features will help in reducing system failure and unplanned downtime for applications and the network. Another advantage of Cloud Computing is agile updating which allows organisations to update IT systems without scheduled downtime [15]. The department also plans to apply proactive and preventative maintenance mechanisms.

4.2. Organisational Capabilities Perspective:

The department managers recognise that the Cloud Computing model will allow the department to develop new capabilities and skills, targeting customers. Cloud Computing helps organisations to provide new services that were not previously possible due to the higher cost of IT solutions [10]. Thus, the first objective in the organisational capabilities perspective is to establish how Cloud Computing will allow the hospital to provide new services. An example of the new range of services that the Cloud could offer is mobile applications. Decreasing IT maintenance tasks will allow IT staff to more time to develop skills and work on innovative ideas. Cloud Computing solutions will increase the organisations' ICT capabilities by allowing the department to leverage the IT capabilities of the service vendor. The managers of the department also hope that by implementing Cloud Computing, the hospital will develop positive relations with other healthcare providers which could ease exchanging of information. This could happen by developing more external interfaces between the healthcare organisations.

4.3. Financial Perspective:

Cloud Computing solutions provide financial benefits for healthcare organisations by helping them to develop a productivity strategy that focuses on better cost performance with more efficiency. Total Cost of Ownership (TCO) for IT services in healthcare organisations is estimated to go down by between 10% to 30% by using Cloud Computing [16]. EHD managers expect that Cloud Computing implementation will lead to decreasing IT costs and this is set as a first objective in the financial perspective. The potential cost saving will arise from reducing the costs of application testing, software licenses and through better IT staff placement. Another strategic goal is to maximise and optimise IT asset utilisation at the hospital. Cloud Computing could help in two ways which are increased percentage of virtualised servers and decreased number of staff allocated to server maintenance. These advantages will lead to better utilisation of scare resources.

4.4. Customer Perspective:

Improving customer perspective performance is one of the primary goals for healthcare organisations. For KFSH, this perspective is the most important view of the developed balanced scorecard. The first objective is to improve customer satisfaction. Cloud Computing will enhance customer satisfaction by improving IT department performance by reducing the percentage of system failures and by reducing time taken to resolve problems. Another objective is improving information access for the customer. Cloud Computing solutions could help the improve satisfaction by allowing new services to be delivered such as self-service stations for patients.

5. Discussion

IT investment in healthcare has significantly increased in recent years, however, the strategic value of these investments is still somewhat unclear [17]. One possible reason is the separation between financial and non-financial measures [18]. IT could provide strategic value as well as cost savings [10]. IT managers at KFSH applied BSC to measure the strategic value of implementing Cloud Computing services at the hospital. For EHD, customers are a combination of patients and staff. Building positive relationships with customers is a vital goal for EHD. Cloud

Computing can improve the department's reputation among stakeholders [19] and could help improve satisfaction rates through enhanced quality of technical support and responsiveness to queries. However, the department should pay special attention to the change management process because a study showed that resistance to the use of new systems is affecting EMR implementation in Saudi hospitals [20]. Although the use of Cloud Computing could raise some privacy and security concerns, these can be reduced by the implementation of Private Cloud solutions. Another important aspect of implementing Cloud Computing in healthcare organisations is the ability to promote patient-centred care [21]. EHD has not considered this aspect. The financial goals set by the EHD department cover two elements. The first was to reduce the cost of IT services by decreasing the costs of application testing and software licences and the second one is ensuring better utilisation of IT resources. Due to the choice of a private cloud solution, EHD is not able to achieve savings in upfront investment. Thus, the cost saving goal could not be easily obtained. Regarding the goal of maximising and optimising IT asset utilisation, this gaol could be achieved through the capabilities of Cloud Computing solutions. The implementation of a Private Cloud will increase the level of transparency about the TCO with some cost savings in operational expenses [10]. The EHD department has also not discussed whether the department will apply a profit-centric model or will stay as a cost-centric department. The department needs to consider hidden costs such as application migration costs. EHD also considered two strategic goals for improving organisational capabilities which were providing new services and improving collaboration with other organisations. Although the EHD department focused more on implementing solutions that would allow access to specialized knowhow, the department still needs to address the importance of changing the culture to support the new business model. The strategic goals of EHD also have not covered an important aspect which is how Cloud Computing helps Research and Development at the hospital. The internal process perspective is also important and could affect the other perspectives. Enhancing department performance could be the primary success factor for system quality [22]. Cloud Computing could help EDH department by enabling more effective management of IT infrastructure. However, the department should consider updating IT staff skills and knowledge for more effective management for IT resources. Cloud Computing can also help the hospital to improve IT resource availability by reducing system failures and downtime for the systems. Although the department managers decided to implement a private Cloud solution, they should consider some hybrid Cloud solutions to gain some public Cloud advantages, such as backup and recovery services [15].

6. Conclusion and future work

This paper discussed an actual application of BSC at electronic health department at a Saudi hospital. The study has focused on the implementation of Cloud Computing from the strategic point view by discussing four perspectives which were internal process perspective, customer perspective, financial perspective and organisational capability perspective. The results of the paper included the strategy maps and the KPIs that were used by the EHD department. The result also highlighted that Private Cloud Computing will provide strategic values for all perspectives with some high expectations for the financial perspective. The implemented BSC has also been discussed by the researchers with the EHD department to make further improvements such as the movement toward as cost-centric model. This paper is one of the few studies that discussed BSC implementation in Saudi Arabia specifically and Cloud Computing strategic values in general. The results of this paper could act as guidelines for similar projects while taking into consideration the uniqueness of each organisation. This paper focused on a particular department rather than the overall organisation which is usually the case with BSC implementation [17]. Future work is to complete the review process of the implemented BSC and to present assessment process for Cloud Computing Decision-Making in the hospital to support the decision makers in this movement.

Acknowledgements

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